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Sustainability Assessment: First Steps for Shoshoni Yoga Retreat

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SUSTAINABILITY ASSESSMENT: FIRST STEPS FOR SHOSHONI YOGA RETREAT

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Preface

I have lived at Shoshoni Yoga Retreat for the duration of my college career. It has been a wonderful balance of school work, yoga, and meditation. Shoshoni has several "sustainable" projects in place already. These include home grown food, solar heated buildings, and robust composting and recycling programs. As a way to give back to Shoshoni I choose to conduct this preliminary study. This is the first time that anyone has systematically looked at the retreat centers usage and emissions and I hope that this information will be valuable as Shoshoni continues to pursue sustainable practices. Additionally, this project was a fulfilling way to incorporate my studies into my life.

Acknowledgements

I want to extend a heartfelt thanks to all of my committee members: Dale Miller, Dave Newport, and Jill Harrison. This project would not have been possible without their help, support, and guidance.

I would also like to thank everyone at Shoshoni. They graciously allowed me to dig through old records and ask lots of questions. I greatly appreciate all the conversations we had about this project and am grateful for all the insight they shared.

Finally, I would like to offer gratitude to my teacher Babaji Shambhavanada for his tireless support and unconditional love.

Abstract

In this practicum thesis I sought to answer the question of how to improve the sustainability of Shoshoni Yoga Retreat. Shoshoni is a non-profit retreat center and residential community located just outside of Rollinsville, Colorado. I conducted a preliminary assessment to examine usage in the areas of energy, water, food, and waste and also inventoried carbon dioxide emissions associated with these usages. I defined sustainability to incorporate environmental sustainability and social sustainability with a strong emphasis on the former. I reviewed relevant literature regarding different forms of sustainability assessment to place this assessment within the existing range of studies.

To conduct this assessment I gathered readily available information from various records, discussions with Shoshoni managers, and physical measurements. I also employed estimations and approximations where records were limited and measurements were not feasible. I established a baseline of usage and emissions for Shoshoni and compared this to national and state averages. The results showed that the retreat center was below the average in every category. In addition to this information regarding environmental sustainability I also examined broader social ramifications associated with Shoshoni's operations.

I discuss several projects already in place at Shoshoni including the transition from propane to wood boilers and solar thermal panels for heating, biodiesel production and the move towards an all diesel fleet, and on-site organic greenhouses and gardens for food production. I also offer specific recommendations within the four main areas of energy, water, food and waste. These include conducting an energy audit for the premises, practicing conservation and efficient use in all areas, offering economic incentives and buying offsets to address emissions from guest transportation, expanding the on-site food production and developing fair trade purchasing practices, developing a conservation and disaster plan for water, and expanding current recycling programs.

Introduction

This practicum thesis is based on a preliminary environmental assessment of Shoshoni Yoga Retreat. The question I addressed is how to improve the sustainability of this organization. In the assessment I defined sustainability to include environmental and social aspects and while I gave substantial focus to natural resource conservation, I also explored social ramifications. Four main areas are examined in the assessment: energy, water, food, and waste. Additionally, I estimated the carbon dioxide emissions associated with these areas.

The purpose of this document is to explain the nature and results of the preliminary assessment of Shoshoni. This research is significant for three main reasons. First, it will help Shoshoni approach its goal of sustainability. Second, Shoshoni is a multifaceted organization encompassing the elements a retreat center as well as those of a residential community. The information from this project could be used to the benefit of other retreats or communities. Finally, while this is only preliminary work, this kind of research provides a partial answer to the larger question of how to transition to a sustainable society.

The scope of this thesis includes establishing a baseline of sustainability for the organization, offering initial recommendations for improvement, and beginning to reconcile the organizations goals with its current state.

I start by providing background information on Shoshoni and defining sustainability. The next section is a review of pertinent literature that includes an overview and comparison of different assessment methods. Following this is the preliminary assessment itself; how it was conducted, what the results were, and a discussion of its implications. The final portion of this thesis offers recommendations and areas of future research.

Background

In this section I describe Shoshoni in terms of it programs, guests, staff, and the center itself. Following this I present several concepts of sustainability and explain the definition that I chose to use in this project.

Shoshoni Yoga Retreat

Shoshoni Yoga Retreat is a non-profit retreat center that offers yoga and meditation classes, workshops, teacher training programs, vegetarian meals and overnight stay. It is located in the Rocky Mountains five miles south of Nederland, Colorado. Visitors come to the center to practice yoga and meditation and to take time to relax and restore. The length of stay for guests can range from one yoga class to several weeks. The retreat center is run by a residential volunteer staff that lives on site throughout the year. The time staff members spend living and working at Shoshoni ranges from one month to decades.

The campus is situated around the main lodge that contains the office, kitchen, and communal dining room. Beyond this there are several guest cabins and staff residences. I little further from the lodge you will find Shoshoni's meditation temples, yoga spaces, and dormitories. There are also several houses occupied by long term staff. Electricity, heating, hot running water, and even wireless internet are accessible throughout the campus. This main campus is easily walkable and surrounded by an extended area of forested land.

Defining Sustainability

The most commonly cited definition of sustainability comes from the Bruntland Commission that states that sustainability means meeting current needs without compromising the ability of future generations to meet their own needs (Bruntland, 1987). In the decades of sustainability research numerous interpretations have been made that are more specific and pertinent to given circumstances. Broad definitions like that of the Bruntland Commission provide an overarching goal and frame of reference while specific ones allow for practical guidance (Lawrence, 2007).

One core element in current definitions is the interconnection between society, economy, and the environment with the idea that these components should reinforce one another (Vos, 2007). The relationship of these components is generally viewed in one of two ways. One sees society, economy and the environment as three overlapping circles with the idea that all three are equally important. The other views them as concentric circles with environment as the largest circle followed by society and then economy (McKenzie, 2004). This view suggests that economy is dependent on society and both are dependent on the environment.

For this project the definition of sustainability encompasses the distinct concepts of environmental sustainability and social sustainability with a strong focus on the former. Goodland and Daly define environmental sustainability as living within the limitations of the natural environment. Their definition entails protecting natural resources by using renewable materials at rates that do not exceed regeneration and ensuring that sinks for wastes are not used beyond their absorptive capacity (Goodland and Daly, 1996). Characterizing a sustainable society is difficult and because these qualities are not easily quantifiable they are often left out of sustainability assessments (McKenzie, 2004). For this preliminary report I use social equity to serve as a broad definition and examine the social consequences related to Shoshoni's operations.

Literature Review

In this review I provide a general overview of the different types of assessment and examine a few tools in detail. This is not meant to be a comprehensive overview of the numerous sustainability assessment methods. In the first section, I present a categorization of different methodologies and briefly discuss them. Following this I describe three well-known and commonly-used sustainability assessment tools: environmental impact assessment and the related strategic impact assessment, ecological footprint analysis, and life cycle assessment.

Categories

According to Ness et al there are three main categories for sustainability assessments: indicators and indices based assessments, product-related assessments, and integrated assessments. Indicators and indices generally offer quantitative measures that represent a state of economic, environmental, or societal development. Such tools can be used to track sustainability trends. Product related assessments focus on the production and consumption of goods and services and analyze the resource use and environmental impact through the life cycle of a product. Integrated assessments are designed to inform decisions regarding polices and projects within a specific region. The focus of such tools can be local or global in scale depending on the project or policy in question (Ness et al, 2007).

Environmental Impact Assessment and Strategic Environmental Assessment

Environmental impact assessment (EIA) falls under the integrated assessment category and is an evaluation of the effects likely to occur from a major project affecting the environment. It is an environmental management tool designed to facilitate conscious decisions regarding project approval and forestall ecologically harmful actions before they occur (Jay et al, 2007).

EIA has its origins in the U.S. National Environmental Policy Act (NEPA) of 1969 and many nations have created similar legislation and assessments. While it was not originally designed to address sustainability, EIA practitioners contributed to developing initial sustainability assessments (Pope et al 2004).

EIA and similar assessments around the world provide an existing platform to introduce sustainability into decision making. As well, practitioners have the benefit of more than forty years of experience with this type of assessment. To incorporate the appropriate concepts the broad definition of sustainable development is used as a guideline or reference point and refined to account for environmental, societal, economic, temporal, and spatial dimensions (Lawrence, 2007). There is also the need for flexibility allowing sustainability to be shaped to a certain extent by specific circumstances. In theory this kind of integrated EIA would provide decision makers with a practical means for determining and implementing sustainable practices (Lawrence, 2007). However, some argue that EIA is too limited. Jay et al demonstrate that while EIA provides information to decision makers, in practice it has little influence over final decisions and falls short of the ambitious goals set forth in NEPA (Jay et al, 2007).

One response to the potential short-comings of EIA was the development of strategic environmental assessment (SEA). EIA's are generally employed only at the project level and while they may result in mitigating the negative environmental effects of a project they often fail to avoid them. SEA was designed to provide information and influence decisions at policy and planning levels (Theriva and Partidario, 1996). It is argued that sustainability efforts are better served by this type of assessment because it integrates an environmental perspective into the planning process (Fischer, 2007). SEA brings environmental and sustainability issues into the discussion earlier in the process than EIA, giving those issues more influence in the resulting projects and policies. This assessment method also has the advantage of addressing cumulative effects of projects and providing a framework for more efficient and effective project level assessments (Stinchcombe and Gibson, 2001).

However there are several challenges to using SEA as a sustainability assessment. First, SEA's have varied widely in terms of procedure and focus. This is partly due to the fact that determining sustainability requires considering a broad range of topics. Because of these discrepancies it is difficult to compare results and translate SEA into different contexts (Fischer and Seaton, 2002). Some also argue that the policy planning model that SEA could inform has limited ability to achieve sustainability goals (Stinchcombe and Gibson, 2001).

Ecological footprint analysis

The ecological footprint analysis (EFA) was developed by Wackernagel and Rees in the early nineties and is an example of an indicator based assessment. EFA is a tool that converts the energy use and material throughput of any economy into the corresponding biological area needed to sustain those activities (Wackernagel and Rees, 1996). This tool can determine the sustainability of a given action, lifestyle, or economy by comparing the amount of land that is required to support it with the land that is actually available. Generally this comparison is made to a calculation of the global carrying capacity. This type of assessment serves to raise awareness about the current state of human activities and to inform decision making.

The concept of sustainability in this assessment method is based on the idea that human society and economy are fully dependent on the environment. Wackernagel and Rees argue that progress towards sustainability requires a shift away from the perspective that nature and society are separate to an understanding of humans as part of the environment. In practice this assessment tends to focus on ecological concerns and does not account for economic or social sustainability (Barrett et al, 2004).

This type of assessment is most effective at the national and global level where flows of energy and material are well recorded and easily relatable to global carrying capacity (Wilson and Grant, 2009). However, substantial work has been done to apply ecological footprint analysis at all scales. This is largely due to the fact that ecological footprint is an easily understood concept and because it puts sustainability in terms of the well-known idea of carrying capacity (Barrett et al, 2004).

While this assessment method has become popular there are several criticisms of EFA in terms of methodology and application. Some of the top methodology concerns include the exclusion of large areas of the Earth from the calculation of global biological capacity, failure to account for the needs of non-human species, and the inability to capture unsustainable forestry, fishing, farming and other practices (Venetoulis and Talberth, 2008). EFA is a relatively new form of assessment and while revisions have been made to the original methodology, further improvements and transparency about limitations will be necessary for it to provide more accurate and useful information (Barrett et al, 2004).

EFA has been successful when it is applied as an educational or awareness-raising tool but many argue that it is not well suited to developing policies. It can be used to inform early level decision making but the assessment is not designed to provide specific policy advice and it is further limited by the fact that it only considers the environmental sphere of sustainability (Stoeglehner and Narodoslawsky, 2008).

Life cycle assessment

One of the earliest and most commonly used product related assessments is life cycle assessment (LCA). The basic idea behind LCA is to assess the environmental impacts associated with a product from the extraction of raw materials through its production, transport and use to its disposal; the life cycle of the product (Klopffer, 1997). The Society of Environmental Toxicology and Chemistry and the International Standards Organization established consistent methodology for LCA (Hauschild et al, 2005). Like Environmental Impact Assessment, LCA was an existing practice that has been modified to serve as a sustainability assessment known as life cycle sustainability assessment (LCSA).

The concept of sustainability in LCSA is defined by the triple bottom line or three pillar model that considers environmental, economic and social impacts (Klopffer, 2008). Traditional LCA is limited to environmental concerns and is unable to address trade-offs between those concerns and ones that are economic or social (Hauschild et al, 2005). To evaluate the sustainability of a product two other life cycle assessments were employed: life cycle costing (LCC) and social life cycle assessment (SLCA). LCC pertains to the economic sphere and accounts for monetary costs associated with a product. It excludes environmental costs to avoid overlap with LCA. SLCA examines social issues like child labor, corruption, and discrimination that are related to a product. LCSA, then, can be thought of as the combination of LCA, LCC, and SLCA (Kopffer, 2008). This combination works best when all three assessments are made using the same framework.

LCSA has been seen as a central tool for addressing unsustainable consumption and production patterns across the world. While LCA tools have been used predominantly in developed nations, the United Nations has created an initiative to spread this practice to developing countries (Hauschild et al, 2005). However, there are limitations to LCA tools' effectiveness. In principle LCSA should be able to inform companies, consumers, and other stakeholders about the sustainability of one product as compared to another but in practice this has been difficult to achieve. Despite the general consistency of methods, the complexity of life cycle analysis leads to discrepancies in the data that is collected as well as methodologies used within various sub-sections of LCA (Finnveden, 2000). As a result it is difficult to reproduce results and show for certain that one product is more or less sustainable than another. Additionally, relevant environmental issues are often excluded (Finnveden, 2000).

Conclusion

Since the emergence of sustainability onto the global agenda, a plethora of assessment tools have been developed. In most cases these tools fall into one of three categories, indicator based assessment, product related assessment, or integrated assessment. Tools within these categories can be used to establish baselines and trends, focus on specific products and services, or directly inform policy decisions respectively.

There is no one tool that is ideal for assessing sustainability. The results and effectiveness of assessment methods are influenced strongly by what definition of sustainability is used and by the goals of those conducting the assessment. While research on sustainability is growing and methodology is improving, consistency, accuracy, and transparency continue to be a challenge for most assessment methods.

Assessment Methods

In this preliminary assessment I collected readily available information in the areas of energy, water, food and waste. I gathered this information from resource records, receipts, and bills. I made estimations and discussed with managers at Shoshoni for areas where records were limited or non-existent. Within each subsection I discussed the specific sources and any measurements and approximations that were necessary. I used this information to determine Shoshoni's current state or baseline and when possible examine trends over recent years.

I employed two methods to approximate the relative environmental sustainability of Shoshoni's practices. First, I compared Shoshoni's total use to national and state averages. Ideally, I would have been compared Shoshoni's use to similar organizations such as other retreat centers or hotels. However, while many of these organizations promote the sustainable practices they employ, there was little information regarding actual usage. Because of this, I compared Shoshoni's use to the average American or American household. I normalized the total use by calculating per capita use and use per square foot in order to make a more direct comparison to the average. I used this method to place Shoshoni's practices within a broader context.

Second, I calculated carbon emissions for energy, food, and waste. For energy and waste, specific calculations were possible and I compared Shoshoni's carbon footprint in these areas with national averages. For food, specific calculations were not possible but I made general comparisons based on amounts of conventionally, organically, and home grown food. I examined carbon emissions for two reasons. First, carbon emissions have a direct effect on climate change. This is enough to make emissions a significant factor to consider for long term environmental sustainability. Second, emissions represent material through-put. High levels of emissions correspond to high use of finite resources while zero emissions or carbon neutrality corresponds to low use of finite resources and expanded use of renewable sources. This is consistent with the definition of environmental sustainability used for this assessment.

Energy

The Energy section was divided into four sub-sections: electricity, propane, firewood, and transportation. I compiled information for electricity using the available records from 2010-2012 sent from United Power (the local utility) and determined the total usage per year. I extracted total usage per year for propane from six years of paper records 2006-2011. The fire wood Shoshoni uses is harvested, stored, and burned on-site but there were no records of use. In order to estimate wood use for the winter of 2011-2012 I measured the storage area and contacted the wood manager to find out how much of that stored area was emptied.

I explored three different areas within transportation: Shoshoni staff transportation, food transport, and guest transportation. Shoshoni's staff transportation is low because all the staff members live on site and most transport occurs within the Shoshoni campus. To estimate the extent of this transportation I reviewed two years of receipts for gasoline and diesel purchases. This represented the most complete record of Shoshoni's transportation; however, because not all travel was accounted for in fuel purchase records the actual effect of Shoshoni transport is likely higher than what I presented in this assessment. I looked at three years of delivery records to find the number of deliveries per year. I multiplied this amount by the distance from the distribution center to Shoshoni (Google maps) to determine the total miles traveled in a year. I reviewed guest records regarding the number of local guests (guest traveling from within Colorado) and long-distance guests (guest traveling from out or state) to estimate guest transportation to and from Shoshoni. I assumed that local guests traveled by car and long-distance guests traveled by plane. I obtained distances traveled by local guests from google maps and then multiplied by the number of trips made from that location. I used an online flight calculator to find distances traveled by out of state guests and then multiplied by number of trips from that state.

Water

Shoshoni obtains its water from an on-site spring fed well. Shoshoni managers provided in-flow estimates and the storage capacity of the well. Water is another area that currently has no record for use. Because of this I made estimates regarding major areas of water use, which included indoor uses like dishwashing, drinking, and laundry, and outdoor uses such as irrigation. The amount of water per use for machines was generally posted on the machine and I contacted Shoshoni managers to determine how often the machines were used in a given time period. I measured various water containers to estimate water use per day for manual dishwashing and cooking and drinking. I determined flow rates for faucets, showers, and irrigation and made estimates regarding amount of time spent watering, showering, etc.

Food

Shoshoni's managers purchase the bulk of their produce and dry goods from distributers. I calculated the total amount of organic and conventional food, in pounds, using three years of delivery records (2009, 2011-2012). Additionally, I used the garden record for the growing season in 2012 to determine the amount of produce grown in Shoshoni's three on-site organic greenhouses.

Waste

I divided waste into the categories of trash, recycling, and compost. To obtain the volume of trash per year I measured the volume of the on-site dumpster and multiplied by 52 (the number of collections per year; once per week). I measured the volume or Shoshoni's recycling containers and also multiplied this by 52 (also take once per week) to find the total amount of recycling. For compost, I measured the volume of containers and then multiplied by 17.3 (added to compost pile once every three weeks). I converted the volumes of all three to weight using EPA standard conversions (EPA, 2012c). For compost and trash this was a simple one factor conversion. For recycling each material type had a different factor. Because a compositional study of recycling was not within the scope of this assessment I assumed that the volume was divided equally among the commonly recycled materials: mixed plastic, aluminum cans, paper, and corrugated containers.

Carbon Emissions

I examined carbon emissions for energy, food, and waste. I calculated specific emissions in metric tons per year. Again, I divided energy into electricity, propane, firewood, and transportation. For electricity I assumed that the utility that provides to Shoshoni, United Power, had a similar fuel mix to Xcel energy. According to the University of Colorado Greenhouse Gas Emission Inventory the conversion factor for Xcel is 1.652lb CO_2 per kWh (UCB, 2011) and this was used to determine the carbon emissions from Shoshoni's electricity use. For propane and firewood I obtained standard conversion factors from the EPA (EPA, 2013d; EPA, 2008). I used standard EPA conversions for diesel and gasoline to find emissions for Shoshoni staff transportation (EPA, 2004). For food transport I used information from CU's Conceptual Plan for Carbon Neutrality to convert miles traveled into fuel usage and then used the same EPA conversions to calculate carbon emissions (Carbon Neutrality Working Group, 2009; EPA 2004). I obtained conversion factors for guest transportation from the University of Boulder Greenhouse Gas Emission Inventory (UCB, 2011).

I divided waste into trash, recycling, and compost. According to the EPA WARM model municipal solid waste generates 3.1 metric tons CO2 per ton of waste (EPA, 2013e). Recycling and compost acted as carbon sinks. This is true for recycling for two reasons. First, it reduces the need for virgin material and carbon intensive extraction processes. Second, it recovers materials that would have otherwise been waste (EPA, 2012a). Compost is also considered a slight carbon sink because of its application to agricultural soils (EPA, 2012b).

It was not possible to perform specific carbon emission calculations for food. Instead I explored the relative carbon intensity of organic and conventional farming in the discussion section. Furthermore, I examined the relative carbon intensity of meat and vegetable production because Shoshoni offers only vegetarian meals.

Assessment Results and Analysis

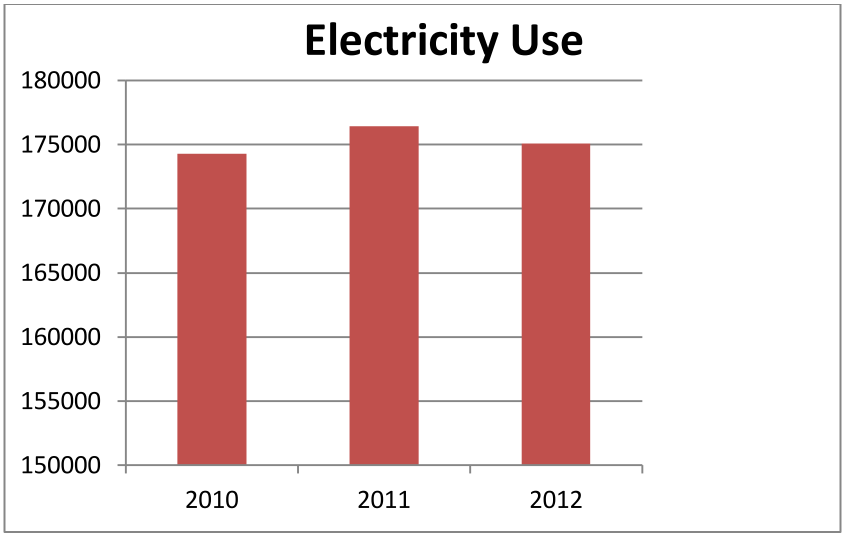
In this section I show the results for each subsection in terms of total use and, where possible, trends over recent years. I also provide comparisons with national and state averages by total use, per capita use or use per square foot. In the final subsection I show the carbon emissions for energy, and waste and compare this to national averages.

Energy

There is a wide range of areas encompassed within energy usage. To account for this I divide this section into the four subsections of electricity, propane, firewood, and transportation. These four distinct areas accurately cover the scope of energy uses at Shoshoni.

Electricity

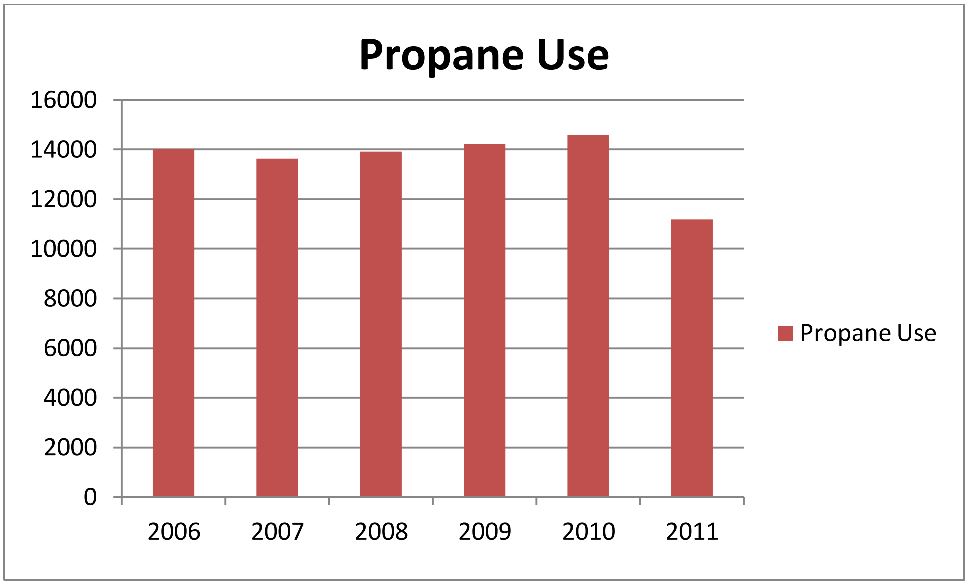
Over the last three years Shoshoni's electricity use has remained relatively constant with an average use of 175256 kWh per year. Figure 1 shows the usage in kWh for 2010-2012.



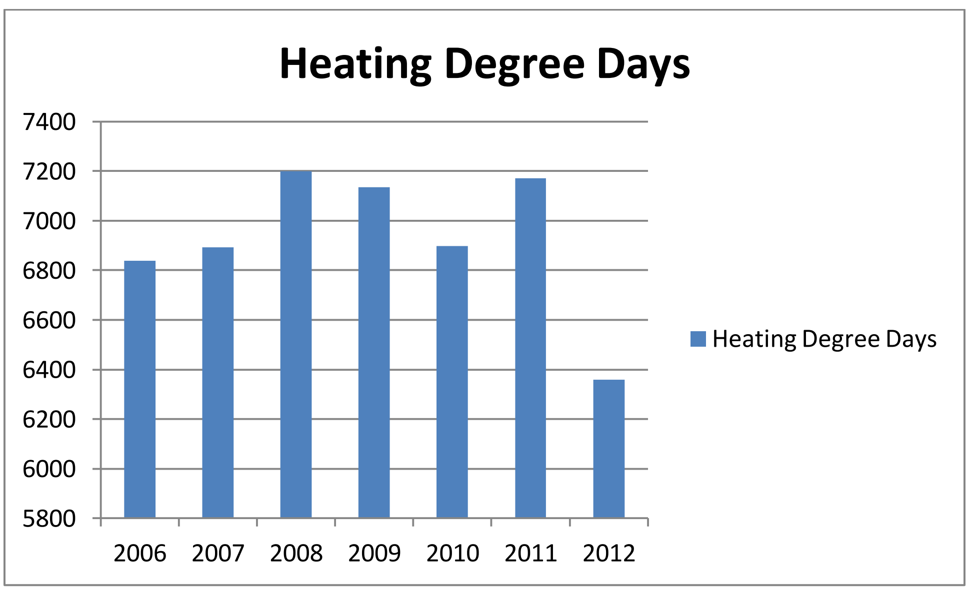
The average Colorado household uses 8532 kWh per year (EIA, 2013a). The amount of electricity that Shoshoni uses would be sufficient to power over 20 households in Colorado. The average square footage of houses in the U.S. is 1971 (EIA, 2009a). Given the average usage and house size I estimate that the electricity use in Colorado is approximately 4.3 kWh per square foot for the average household. Shoshoni's use is 1.75 kWh per square foot; less than half that of the state average.

Propane

Over the last six years Shoshoni has used an average of 13597 gallons of propane. The figure below shows usage from 2006-2011. The usage from 2006-2010 was relatively steady but there was a 24% decrease from 2010- 2011.



In an attempt to account for this decrease I normalized this information by heating degree days. Heating degree days are a measure of how cold it is in terms of how much heating is needed for a given time period. This normalization shows how many gallons of propane were used for each unit of heating. I suspected that the decrease may have been due to an unusually warm year.



However, this was not the case. As can be seen in the figure above, 2011 was a relatively cold year. In fact, Shoshoni's use of propane in 2011 was the most efficient use within this six year time frame. A more likely explanation for the decrease is the transfer of several buildings to firewood as the primary heating source between 2009 and 2011.

The average home in the western U.S. uses 73 million BTU of energy for heating (EIA, 2009b). The BTU content of Shoshoni's average year of propane use is 1.24 billion BTU; enough to heat 17 homes (EIA, 2013b). The average heat used in the U.S. is roughly 37,000 BTU per square foot. Shoshoni's usage is 12,400 BTU per square foot and is almost three times less than the national average.

Fire Wood

During the winter of 2011-2012 Shoshoni consumed 69.2 cords of wood. The bulk of Shoshoni's wood is lodge pole pine and the heat content of a cord of this wood is 22.3 million BTU (World Forest Industries, 2013). The total heat content of Shoshoni's firewood use was 1,543 million BTU. Comparing this again to the average of 73 million BTU needed to heat an average home in the west, this would be enough to heat just over 21 homes. Shoshoni's usage for firewood is 15430 BTU per square foot; less than half the national average. Even when the heating from propane and wood are combined, 27,830 BTU per square foot, it is still less than the average.

Transportation

Between 2011 and 2012 Shoshoni consumed an average of 618 gallons of gasoline and 145 gallons of diesel for transportation. Given an average fuel efficiency of 22.5 mpg this translates to approximately 17167 miles of travel (EPA, 2013f). This amount is relatively small;

similar to the average 11600 miles traveled per vehicle per year in the U.S. (US Census Bureau, 2012).

Food transportation for Shoshoni increased from 2009 to 2011 but remained the same in 2012. In 2009, there were 2806 miles of travel associated with deliveries. In 2011 and 2012 this amount was 3477 per year. This is less than Shoshoni's travel and the average travel for U.S. vehicles but it is not a full account of the travel necessary to send Shoshoni's food from farm to table.

The most significant source of travel is guest transportation. Thousands of people visit Shoshoni every year and this amounts to hundreds of thousands of miles of travel. For 2012 this was 99,803 miles for car travel and 708,700 for air-travel. That is equivalent to eight or nine cars driven for a year and according to a Gallup poll, Shoshoni's air travel would be equal to that of over 250 Americans (Jones, 2007).

Water

Shoshoni obtains water from an on-site spring-fed well with a storage capacity of 18,000 gallons. The incoming flow rate ranges from 3.5 gallons per minute in the fall and winter to 10 gallons per minute during the spring. If there is overflow the water is fed back into the surrounding ecosystem. The estimated total use of water for the typical year at Shoshoni is just over one million gallons. This equates to an average water use of 91 gallons per person per day. In the peak season, with more people and more time spent watering gardens, use can be as much as 129 gallons but in the off season this drops to 52 gallons.

Shoshoni's use is lower than the average use in Colorado which ranges from 101-125 gallons per person per day (EPA, 2013a).

Food

The amount of food consumed at Shoshoni has increased from 2009-2012, in fact it has more than doubled going from 11431 pounds in 2009 to 23854 pounds in 2012. The consumption per person per day at Shoshoni for 2012 was 2.06 pounds. In a year the average American consumes nearly one ton of food, 1993 pounds (USDA, 2000). This translates to 4.7 pounds per person per day. The level of consumption at Shoshoni is less than half that of the national average.

Shoshoni buys a mix of organic and conventional food and in the last year has begun to produce significant amounts from three on-site greenhouses. Over recent years purchase and production of organic food has increased. In 2009 the amount of organic food was almost equal to the amount of conventional food, representing 52 percent of food purchased from distributers. In 2011 this increased to 67 percent and in 2012, with the addition of produce from the organic greenhouses on-site, organic accounted for 80 percent.

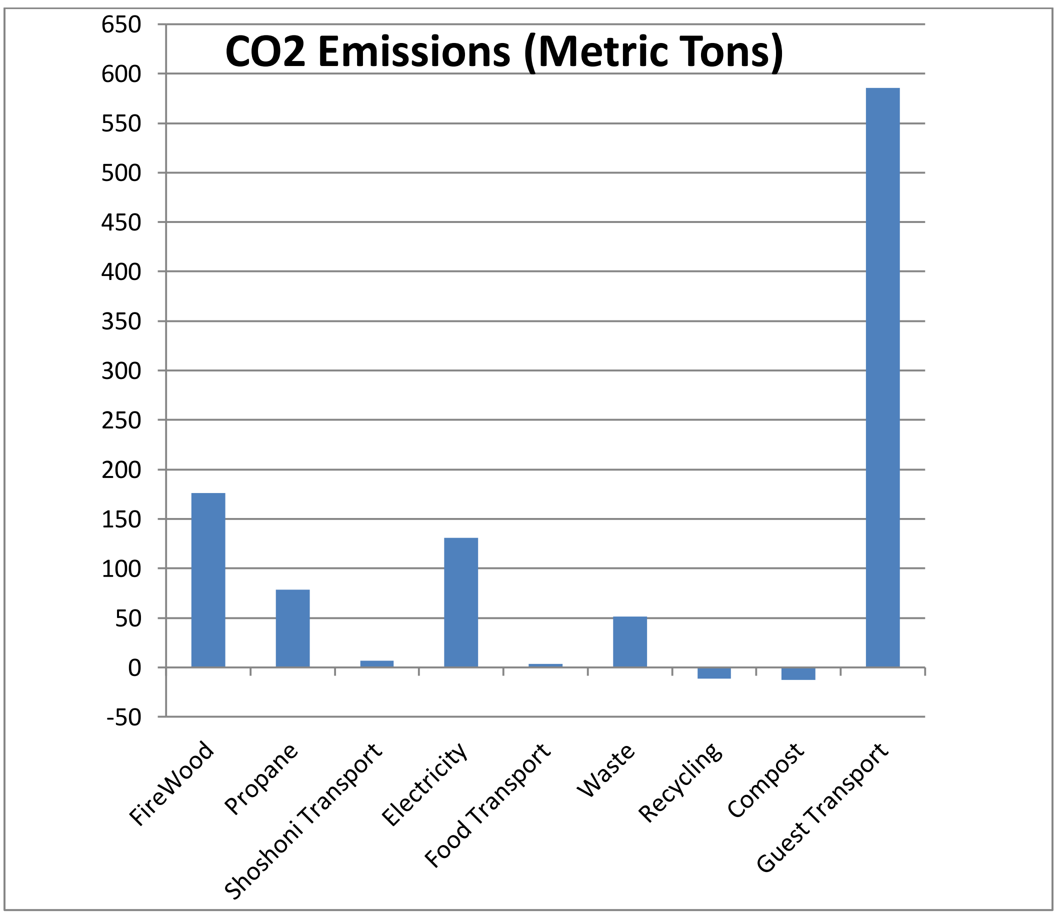
Waste

In 2012 Shoshoni produced 11-22 tons of trash, 2-4 tons of recycling and 10 tons of compost. Shoshoni's estimated diversion rate is between 35-56 percent. This is higher than the national average of 34 percent (EPA, 2011). Shoshoni guests and staff produce an average of 33222 pounds of garbage a year or about 2.84 pounds per person per day. This is lower than the national average of 4.43 pounds per person per day (EPA, 2011).

Carbon Emissions

The carbon emission for Shoshoni's energy use and waste in 2012 was 1,010 metric tons. This level of emissions is relatively small but it is important to note that this is not Shoshoni's total carbon emissions. I did not fully account for food transportation and did not include food production. Shoshoni's emissions would be higher if this was included as production accounts for over 80 percent of food emissions. Bearing this in mind, I continue with comparisons using the value for known emissions.

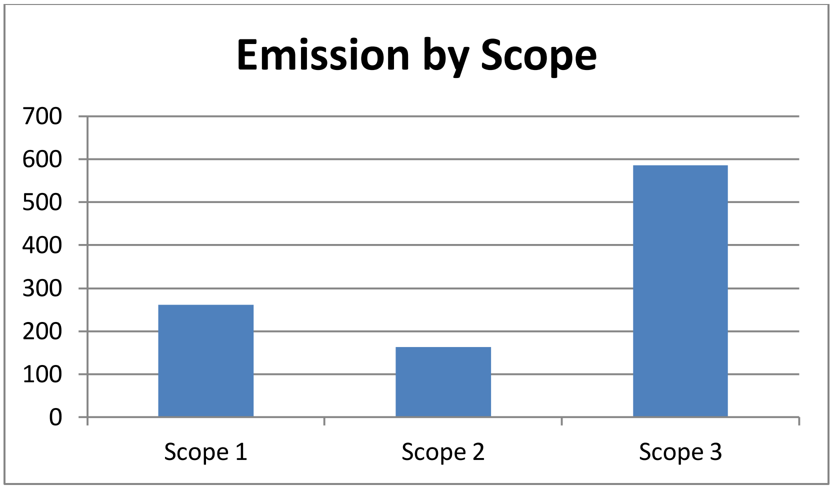
The average person in the US generates 19.7 metric tons of carbon dioxide each year thus Shoshoni's emissions are equal to that of just over 50 people. In 2012 Shoshoni had 2434 guests. If we account for this population, Shoshoni's emission per person is 0.4 metric tons. This is considerably lower than the national average. The figure below shows emissions by area.



The second highest emission comes from firewood; however, it should be noted that net emissions from burning wood are zero because trees act as carbon sinks during their lifetime. The highest emission is from guest transportation, which dwarfs the other sources and accounts for 58 percent of the total. This is similar to the situation in Rocky Mountain National Park, RMNP. In 2005, RMNP emitted 3540 metric tons, 78 percent of which was from transportation within the park (RMNP, 2007). A direct comparison of Shoshoni to RMNP is difficult as the park has nearly three million visitors each year (ibid), much higher than Shoshoni's average 2000, but does not offer as many services as Shoshoni does. However, because both organizations are similar in geography as well as the structure of their emissions I review RMNP's greenhouse gas reduction strategies in the discussion section.

I further divide emissions by scope. Scope 1 pertains to emission sources that Shoshoni owns and controls, like propane. Scope 2 encompasses emission sources that Shoshoni owns but a third party controls. An example for this is electricity. Shoshoni purchases the electricity, owns it, but does not control the fuel mix used to generate the electricity. Scope 3 refers to emissions that are neither owned nor controlled by Shoshoni but that are still associated with Shoshoni. The only element that falls under scope 3 for Shoshoni is guest transportation. Guests are responsible for their travel emissions but they are traveling in order to visit Shoshoni. The table below shows which scope each source falls into and the following figure shows emissions by scope.

Scope 1	Firewood, Propane, Shoshoni Transport
Scope 2	Electricity, Food Transport, Waste
Scope 3	Guest Transportation



Social Sustainability

In this section I highlight the social implications involved regarding Shoshoni's use of energy, water, food, and waste. The goal of this section is to put Shoshoni's practices into a broader social context. Several of these issues are not directly related to Shoshoni's practices in terms of either their cause or potential solution but they are important to consider to better understand the social landscape within which Shoshoni operates.

Energy

Energy production produces several social problems. Power plants have serious effects on the surrounding environment and the health of nearby communities. Coal accounts for 45 percent of electricity production in the U.S. (Environmental Health and Engineering, 2011). Health effects from coal-fired power plants include cancer, neurological damage, cardiovascular and pulmonary disease, and various other negative effects (ibid). Research indicates that in the vast majority of cases these polluting facilities disproportionally affect poor and minority communities (Wilson, et al., 2012). As long as Shoshoni's electricity is provided by coal-burning sources, Shoshoni will be indirectly contributing to this problem.

Water

Water is a vital resource and it is predicted that climate change will, in many areas, increase demand for water while decreasing supply (EPA, 2013b). In the west water supply is already an issue; one that will only increase with population growth and more frequent drought caused by climate change (ibid). Shoshoni owns the rights to a natural spring well and because of this Shoshoni may have a special responsibility to conserve. Currently, Shoshoni is using water below the state average. However, as climate change takes effect the possibility increases that Shoshoni's well may run dry. The alternative plan of buying water from sources in the Boulder-Denver area and trucking it up the mountain is costly both economically and in terms of CO2 emissions. This would also increase competition for water in an increasingly water scarce situation.

Food

The social sustainability of food is a complex issue. The agricultural system in the U.S. has a history of social abuse. Farmers have recruited and exploited marginalized populations of migrant laborers since the 19th century to maintain a cheap and compliant labor supply (Harrison, 2008). Current problems include unsafe and unhealthy working conditions, lack of legal protection, and unlivable wages.

There are two federal regulations designed to protect these workers: The Fair Labor Standards Act, FLSA, and The Migrant and Seasonal Agricultural Worker Protection Act, MSPA. The Fair Labor Standards Act was created in 1938 and ensured that most laborers received minimum hourly wages and stipulated overtime wages for hours worked over 40 hours per week (WHD, 2008). This act did not include farm workers until 1966 and currently only provides minimum wage. It does not provide overtime wages to farm workers and workers on small farms are still not guaranteed minimum wage (ibid).

MSPA provides certain protection regarding recruitment, wages, transportation, and housing (Colorado Legal Services, 2013). Many migrant farm workers are recruited by farm labor contractors. In some cases these contractors have refused payment to workers and have subjected them to debt peonage and even slavery (Farm Worker Justice, 2013). Part of the MSPA dictates that all farm labor contractors must register with the U.S. Department of Labor before recruiting, transporting, or housing farm workers. Additionally, this act mandates that wages must be given on time and include a written statement of payment, transportation must meet appropriate safety standards, and housing must meet both state and federal safety and health standards (WHD, 2008).

This legislation is valuable but problems still persist. Farm work is a hazardous profession. The death rate in agricultural work is over five times higher than the industry average (Reeves, et al., 1999). Beyond this, farm workers also have the greatest risk from pesticide exposure. In Colorado, 59 percent of farm workers reported that they did not receive pesticide training, 49 percent reported experiences of pesticide exposure, and 41 percent did not have access to water to wash off pesticides (Jackson, 2002). Additionally, minimum wages are not always met, especially for those working a piece rate, being paid per unit instead of hourly (Colorado Legal Services, 2013). These issues are compounded by the fact that this population is politically disenfranchised. Most migrant farm workers are immigrants, poor, and 50-90 percent of them are unauthorized (Harrison, 2008).

Without knowledge about the practices on the farms delivering to the distributors that Shoshoni uses it is difficult to understand how the retreat center's purchasing practices relate to these issues. Presently, there are three movements working to address these labor issues: farm worker unions, the Coalition of Immokalee Workers, and the Domestic Fair Trade Association, DFTA. While it is not known how Shoshoni's practices could support the first two, the retreat center may be able to pursue fair trade labels overseen by the DFTA.

Farm worker unions have historically attempted to organize workers and demand contracts from employers and push for legislation by protesting, striking and establishing boycotts. The most well-known and successful of these unions is the United Farm Workers, UFW that at its peak in the early 1980's held 120 contracts and protected over 60,000 workers (Majka and Majka, 2000). While this and other farm worker unions have declined since the eighties these organizations are still fighting to protect worker rights.

The Coalition of Immokalee Workers is a community-based worker organization. This organization makes demands similar to farm unions for increased wages and improved working conditions. However, unlike unions, this group does not seek individual contracts with employers but instead works for industry wide reform for the farm workers of southern Florida. Since its formation in 1993, this grass-roots organization has grown to become a political force in Florida and has been successful at obtaining agreements from major agricultural buyers such as super markets, fast-food restaurants, and the food service industry (CIW, 2013).

One other group that is worth mentioning is the Domestic Fair Trade Association. This is a membership organization that is developing criteria for the promotion and creation of domestic fair trade programs such as labeling and certification (DFTA, 2010). Their mission is to maintain high standards within these programs and their goal is to help stakeholders create a movement towards sustainable agriculture in North America (ibid). Within the principles of domestic fair trade are the rights of farm workers to fair wages, participation in decision making, freedom from toxins, and the freedom to organize (Brown and Getz, 2008). However, because of the diverse member base and focus on small family farms, tensions often arise between the interests of small farmers and farm workers and it is not clear whether DFTA's efforts will be able to address labor issues (ibid).

Waste

The issue with waste is similar to that of power plants. Dump sites are usually located in poor and minority areas (GAO, 1983). The most severe health effects associated with landfills have to do with migration of landfill gas through the air to surrounding communities. These gases include carbon dioxide, methane, volatile organic compounds, and hazardous air pollutants and can cause cancer, respiratory illness, and central nervous system damage (EPA 2013c). Other problems include unpleasant odors and underground migration of gas that can lead to explosions (ibid).

Shoshoni's waste is taken to Foothills Landfill in Golden, CO. This site is located one mile from Golden in an area overlooking the flatirons. While it is a shame that this beautiful land is being used for a dump, it is not clear that this site has caused any negative effects for the nearby community.

Discussion and Recommendations

In all areas, Shoshoni's usage and emissions are less than the average person or household in the nation. While this information is encouraging, there is always the need to improve, especially considering Shoshoni's long term goal of self-sufficiency. In the following section I discuss current and future projects at Shoshoni, challenges to increasing sustainability, and offer recommendations.

Energy

Fire wood, propane, and Shoshoni's vehicle fleet are the areas where Shoshoni can most easily make change. Over the past few years, Shoshoni has purchased three high-efficiency wood boilers and is transitioning away from propane towards wood. In terms of CO2 emissions this is beneficial as firewood is carbon neutral. The long-term sustainability of wood heating is not clear; however, as the renewable capacity of Shoshoni's forest land is unknown at this time.

As well as increasing the use of wood boilers, Shoshoni has also begun using solar thermal panels on several of its buildings. This practice may provide a better solution as it is both renewable and emits no carbon during use. A notable achievement in this area is Shoshoni's latest building that is heated without propane by passive-solar design, solar-thermal panels, and a single wood boiler.

Most buildings and spaces on the campus are not heated or only minimally heated when they are not occupied. To further reduce heating needs, Shoshoni could systematically incorporate this practice to all spaces on the premises. To increase heating efficiency Shoshoni could conduct an energy audit to determine where leaks are and where installing more insulation would be most effective.

Some work is already being done to address Shoshoni's fleet. In Eldorado Mountain Yoga Ashram, Shoshoni's sister ashram in Boulder, there is presently a bio-diesel generator that produces fuel for one truck and one tractor. This production could be expanded and Shoshoni is considering switching to an all diesel fleet. To reduce overall usage Shoshoni could train staff to use vehicles only when necessary and to walk instead of driving when traveling around campus. Shoshoni rarely purchases vehicles but should consider buying smaller more fuel efficient vehicles when it does.

Two areas where Shoshoni can also direct change are electricity and food deliveries. As long as Shoshoni buys power off the grid it is subject to the fuel mix of the utility. Currently this is 67% coal, 12% hydro, 5% wind, 1% natural gas, and an additional 15% that this utility buys. The last 15% has an unknown fuel mix but is probably mostly coal. To address this issue Shoshoni could reduce use by using natural lighting whenever possible. Presently, Shoshoni uses compact florescent light bulbs and many Energy Star rated appliances. To increase efficiency Shoshoni could replace old appliances with more energy efficient models and could consider switching to LED lighting.

Another way Shoshoni can address this issue is to generate its own electricity with renewable sources. Shoshoni is considering installing a wind turbine and solar-voltaic panels but such initiatives are not likely to occur in the near future. Developing a feasibility plan for on-site renewable production may facilitate this process. Decreasing electricity use from reductions, efficiency, and renewable power will lower Shoshoni's carbon emissions and is also socially beneficial. Less purchased electricity means less coal and associated pollution to nearby communities.

For food deliveries, expansion of Shoshoni's on-site gardening could be a solution. Effective communication may be the first step. In 2012, Shoshoni's garden produced over 4000 pounds of produce; however, the same amount of food was purchased from distributors in 2012 as was in 2011. The effect was that Shoshoni's garden produce was used mainly to supplement meals and in some cases led to increase consumption because the chefs needed to use the fresh produce before it expired. Communication between those in charge of growing the food and those purchasing it will help eliminate redundancies and make sure the gardens are growing food that is integral to meals and in a time frame that allows optimal usage.

The final area in energy is guest transportation. This is the most significant source of carbon emissions for the retreat center but Shoshoni has no direct control over it. As mentioned previously RMNP had similar problems with guest transportation. Their strategies for lowering these emissions involved expanding the parks shuttle service and charging higher entrance fees for large vehicles and lower fees for hybrids and carpooling (RMNP, 2007). The first of these strategies is not practical at Shoshoni as travel within the campus is not an issue. The second option is potentially valid. The general population attracted to the retreat center is open-minded and may be receptive to behavioral changes. This could be especially attractive if there was a price incentive such as a discount if you take the bus, carpool, walk, or bike to come to Shoshoni.

The emission associated with long-distance guests was much higher than that of local guests. Shoshoni could tailor its programs to locals and slowly shift its guest demographic. However, Shoshoni does not want to discourage long distance guests from coming. Instead the retreat center could attempt to reduce long distance guest emissions by encouraging them to take the bus to Shoshoni instead of renting a car.

The main draw for people coming to Shoshoni is the retreat aspect of the center. Most guests are seeking a break from their lives and want to spend time in Shoshoni's beautiful mountain setting and enjoy the company of other yogis. This may limit the retreat centers ability to provide its service in a less carbon intense manner. However, Shoshoni's managers should at least discuss other possibilities. These might include offering more online services or conducting workshops out of state.

Alternatively, Shoshoni could consider offsets to address this and other sources of carbon emissions that cannot be directly reduced. Essentially an offset involves paying a third party to reduce carbon emissions in your name. The idea behind this is that the effect that carbon dioxide emissions have on the atmosphere is not dependent on the geographical location of the emission. Thus if you support an effort to reduce emissions elsewhere, the end result is the same as reducing emissions in your own operations (ACUPCC, 2008). Offsets should only be considered once all conservation, efficiency, and renewable power options have been exhausted. They should not be used to substitute for direct reductions but could provide an avenue for achieving carbon neutrality

There are many different offset projects with a wide range of credibility. Reliable offset projects need to be measurable, permanent, and verified by a third party (ibid). It is also essential to establish a credible baseline to demonstrate actual emission reductions that are additional to what would have taken place otherwise. The other component of this additionality is to determine that the project is happening because of the funding from the purchaser (ibid). If the reductions from the project could have or would have happened anyway then the offset is questionable if not entirely null.

Other environmental and social impacts of proposed reduction projects should be considered. Local offsets is a nascent term that refers to offsets that meet the standards mentioned above and also produce social benefits in nearby communities. Two examples from The University of Colorado show what this might look like. In 2012, CU helped fund a landfill methane capture program that supported a family owned brick company in Wewoka, Oklahoma (CU Environmental Center, 2013). This project reduced emissions from methane, allowed this kiln to operate with less fossil fuels, and supported this rural towns largest employer (Native Energy, 2013). The second example involved funding the installation of solar thermal panels of low income housing in Loveland, Colorado (CU Environmental Center, 2013). Basically, these types of offsets allow for improved sustainability for people that otherwise could not have afforded it and contributes economically by providing savings or additional revenue.

Shoshoni should pursue offsets carefully and only invest in credible projects. Offsets present the retreat center with a way to achieve carbon neutrality while it continues to work on reducing its own emissions. Offsets, especially local offsets, also allow Shoshoni to improve sustainability beyond its own borders.

Water

Currently Shoshoni uses water efficiently and below the average for the state. Shoshoni uses water efficient facets, shower heads, toilets, and laundry machines. Additionally, signs are posted that encourage guests to be mindful of water use during showers, etc, and to re-use towels to limit the need for laundry. For irrigation, hand watering is preformed minimally and most areas use drip systems. Also no water is used for landscaping; the grass is allowed to turn green and brown with the seasons.

Water metering could help with management. While usage is relatively low, there is little knowledge regarding which areas are using the most water. This limits the potential to effectively conserve and in the past has made it difficult to determine sources of water loss. Training staff to use water appropriately and stressing the importance of water conservation would also be beneficial. Another possible improvement would be the use of grey water systems to reuse water and reduce the use of potable water.

Beyond these adaptations, Shoshoni should develop a disaster plan for water. Currently, when the well is low and cannot supply Shoshoni's water needs, a truck is sent to Boulder to buy water and drive it back up to Shoshoni. This course of action is necessary occasionally but it would not be an optimal long term solution if Shoshoni's well ever ran dry.

Food

In 2012 Shoshoni consumed over 20 thousand pounds of food, about 2 pounds per person per day. One notable advantage to Shoshoni's food situation is that the retreat center is vegetarian. A diet that does not include meat can reduce carbon emissions from food by up to 40 percent (Center for Sustainable Solutions, 2012). Additionally, the trend in Shoshoni's consumption is toward organic and home-grown food.

The move from conventional food to organic food can reduce pesticide use and potentially carbon dioxide emissions. USDA certified organic does not allow for the use of synthetic pesticides. As such, supporting organic agriculture could reduce pesticide exposure for both consumers and farm workers. At this time there is not a clear correlation between organic production and reduced carbon dioxide emissions. However, it has been found that conversion of farmland from conventional to organic does reduce emissions (Venkat, 2012). Purchasing more organic food is potentially beneficial but moving to all organic food may not be economically feasible at this time.

Expansion of Shoshoni's on-site gardens and greenhouses would increase the retreat center's social and environmental sustainability. Currently, this food production is socially fair and organic. No synthetic fertilizers or pesticides are used and members of Shoshoni's volunteer staff cultivate the food under safe and healthy working conditions. It will also be carbon neutral with introduction of solar powered fans and solar panels. Ideally, Shoshoni would produce all of its food on-site but self-sufficiency may not be possible in this area. As well on-site production is costly to maintain and the amount of food produced is not translating directly into savings from food purchasing. Better communication may alleviate some of this problem. With continued purchases Shoshoni should consider developing fair trade purchasing practices. These practices could include buying produce with fair trade labels as it becomes available or developing direct relations with local farmers and farm workers.

Waste

The amount of waste produced at Shoshoni is relatively low and the diversion rate is above the national average. Current composting and recycling programs also help to reduce Shoshoni's carbon footprint. Decreasing purchase of single-use items whether they are disposable, recyclable, or compostable would help reduce overall waste. Paper napkins and hand towels are examples of items that the retreat center could discontinue using. Shoshoni's recycling program could be expanded to include hard-to-recycle materials. With the CHARM center in Boulder transport would be relatively easy. A first step in this direction could be placing hard-to-recycle collection containers in the main lodge to be used by staff. Another area that is significant in terms of waste is construction. There are always various construction projects under way and while this area was not explored in this assessment it is a potentially significant source of waste. Introducing recycling and re-use into this area could prove helpful.

Future Research

This preliminary assessment opens the way for continued sustainability research at Shoshoni. A practical next step would be to conduct a more refined version of this same assessment; re-evaluating Shoshoni's practices regarding energy, water, food, and waste using more accurate measurements and approximations. Establishing measurement systems for areas that currently have no record would help facilitate this process. Revisiting this assessment and inventory periodically would help the retreat center to understand trends in usage and to stay current with technical advances and new sustainable practices. A feasibility study looking into the implementation of various recommendations offered in this assessment would help the retreat center act effectively on the information provided.

Beyond this, it would be interesting to explore broader ecological effects perhaps employing an ecological footprint assessment. Additionally, more detailed research could be done on Shoshoni's inputs and outputs like for example the exact location and effect of the power plant that provides the retreat's electricity or the nature of the farms that feed into the distributors Shoshoni uses.

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